

Chapter 4

Southeast Coastal
Condition

Southeast Coastal Condition

The overall condition of Southeast Coast estuaries is fair to good, although there is evidence of human-induced stress in some areas. In 2000, the NCA collaborated with state resource agencies in the region to facilitate collection of environmental stressor and response data from 151 locations (Figure 4-1)

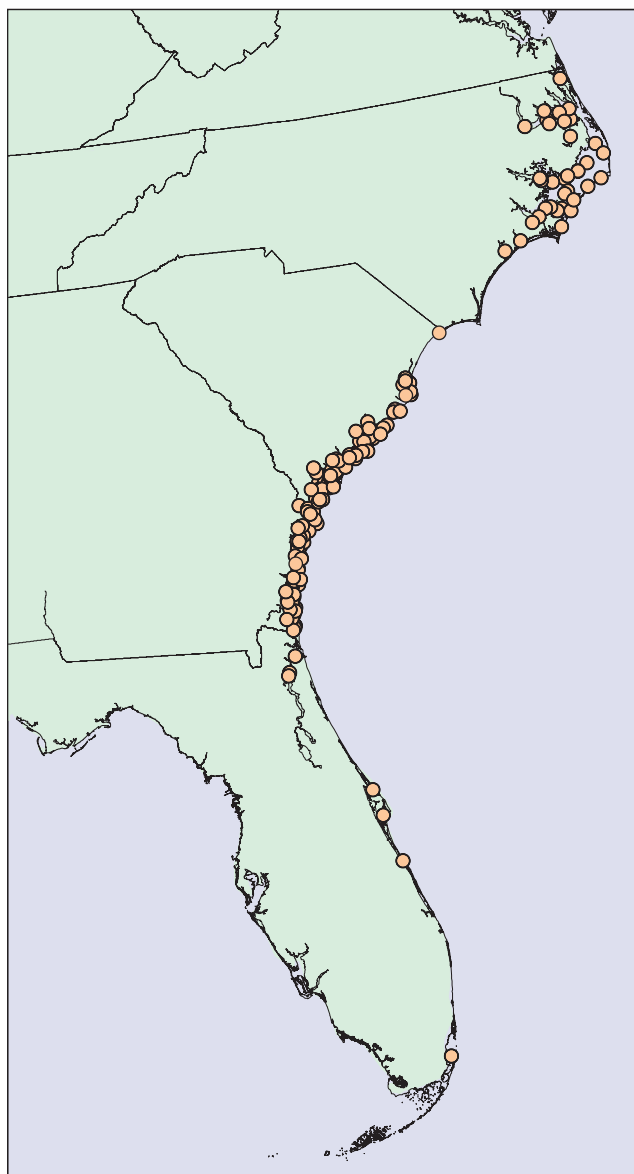


Figure 4-1. Southeast Coast sampling stations (U.S. EPA/NCA).

throughout Southeast Coast estuaries using comparable methods and techniques. Results indicate that most of the estuarine area of the southeastern United States is in fair to good ecological condition. This means that in the late summer, when data were collected, environmental stressors (e.g., nutrients, contaminants) and conditions for aquatic life showed few signs of significant impairment (Figure 4-2). Forty percent of the estuarine area fully supports human and aquatic life uses, 37% is threatened for human and aquatic life use, and 23% is impaired for these uses (Figure 4-3).

The estuaries of the southeastern United States (Carolinian Province) extend from Cape Henry, Virginia, through the southern end of the Indian River Lagoon and along the east coast of Florida (Figure 4-1)

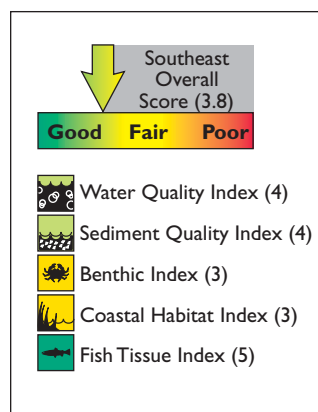


Figure 4-2. The overall condition of Southeast Coast estuaries is fair to good.

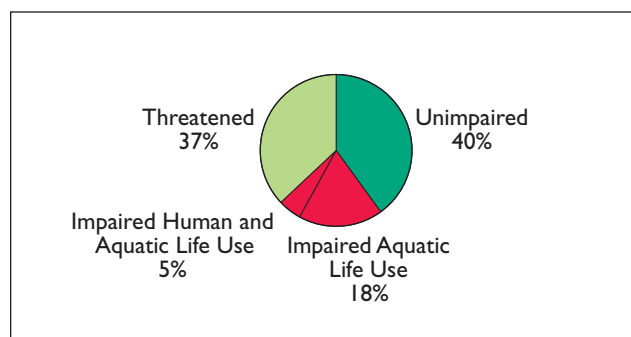


Figure 4-3. Southeast Coast estuarine condition (U.S. EPA/NCA).

to include part of the West Indian Province from Indian River Lagoon through Biscayne Bay. This region of the country is referred to as the Southeast Shelf LME. The Southeast Coast region contains a wealth of resources, including barrier islands such as North Carolina's Outer Banks; busy shipping ports in Miami and Jacksonville, Florida, Savannah, Georgia, and Charleston, South Carolina; quiet coastal wetlands that provide a habitat for migratory birds and other animals; and important commercial and recreational fishery resources. North Carolina contains the Albemarle-Pamlico Sound, one of the largest and most productive aquatic systems in North America. The sound represents North Carolina's key resource base for commercial fishing, recreational fishing, and tourism. Similarly, the coastal resources in other Southeast Coast states provide the resource base for fishing and tourism industries and generate vast amounts of sales tax income for those states.

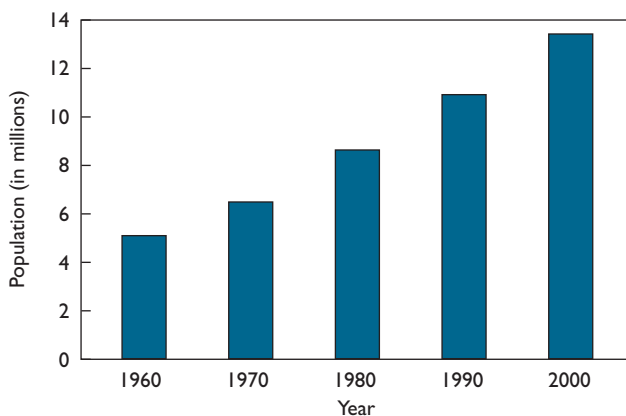
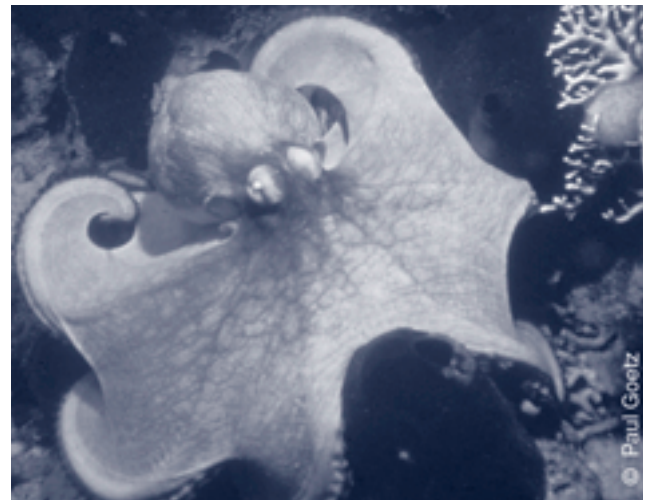


Figure 4-4. Population of coastal counties in the Southeast Coast states from 1960 to 2000 (U.S. Census Bureau, 2003).

The population of coastal counties along the Southeast Coast increased 64% between 1970 and 1990 (U.S. Census Bureau, 1996). In 1999, the southern region of the United States was the most populous area of the nation, accounting for 96 million residents. Florida was among the five most populous states in 1999 (U.S. Census Bureau, 2001) and has demonstrated a growth rate of almost 2% per year in its coastal population. Figure 4-4 presents population data for Southeast Coast counties from the U.S. Census Bureau and shows that these coastal county populations have more than doubled since 1960.

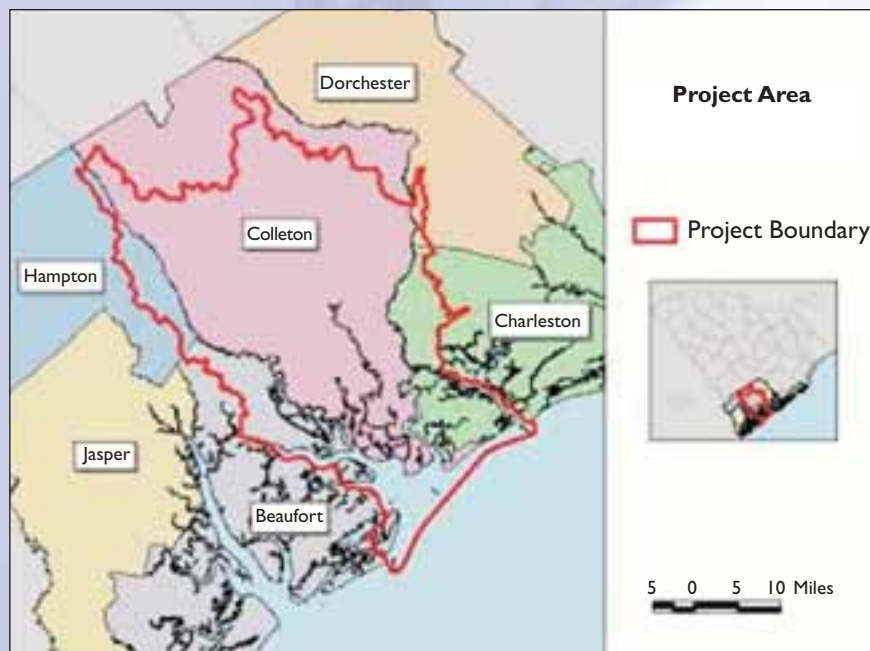
The estuarine resources of the Southeast Coast are diverse and extensive, covering an estimated 4,487 square miles. The coastal population in the southeastern United States increased by 160% over the 40-year period from 1960 to 2000, the largest percentage increase in the country. Given the influx of people and businesses to southeastern coastal states and the ensuing pressures on the coastal zones of this region, there is an increased need for effective management of the resources of the Southeast Coast.



This largest of the Atlantic octopus species, *Octopus vulgaris*, exhibits a threat display to thwart the attention of an inquisitive diver (Paul Goetz).

South Carolina's Ashepoo-Combahee-Edisto Basin National Estuarine Research Reserve System

The Ashepoo-Combahee-Edisto (ACE) Basin of South Carolina has largely undeveloped tracts of saltwater marshes, maritime forests, upland pines, and bottomland hardwoods. These ecologically important components, coupled with management goals that balance conservation of natural resources with economic development and population growth, have focused national attention on the ACE Basin. Colleton County, South Carolina, in which the ACE Basin study area is located, is expected to increase from its 1990 population of 34,377 to more than 47,500 by the year 2010. People are attracted to the ACE Basin's mild climate, rural character, affordable land prices, recreational opportunities, and natural setting; however, extensive population growth and urbanization may adversely impact the very things that draw people to this area. Stressors associated with such population growth include habitat loss, resource depletion, nonpoint source pollution, and nutrient loadings to estuaries and coastal waters.



Ashepoo-Combahee-Edisto (ACE) Basin

A major challenge for the basin's rural communities will be to strike a balance between supporting the area's socioeconomic needs and protecting its natural resources. This will require strong ecological research and a commitment to responsible growth. Conservation, research, education, and cooperation have provided the basic architecture for the ACE Basin National Estuarine Research Reserve System (NERRS). The reserve is managed by the South Carolina Department of Natural Resources (SCDNR), and a 21-member steering committee representing local business, education, forestry, fisheries, environmental groups, tourism, and private landowners guides the development of research and educational activities. Funding for the ACE Basin characterization has been provided by NOAA and the SCDNR. The SCDNR and its Divisions of Marine Resources; Land, Water, and Conservation; and Wildlife and Freshwater Fisheries implemented the project in partnership with NOAA's Coastal Services Center in Charleston, South Carolina, and the National Geophysical Data Center in Boulder, Colorado.

Because of its relatively pristine nature, the ACE Basin provides ideal sites for monitoring changes in the physical and biological aspects of the region. Interdisciplinary research provides information for conserving biological diversity and for assessing the impacts of pollution on ecosystems and habitats. In addition, the ACE Basin may offer a model for solving similar problems in other coastal regions. Local communities are being introduced to the idea that promoting sustainable development and protecting natural watersheds are advantageous to the region's long-term benefit. Outreach activities that strengthen the community's understanding of these concepts are vital to the region's preservation.

For additional information, please visit the following Web sites: <http://www.csc.noaa.gov/acebasin/> and <http://www.dnr.state.sc.us/marine/mrri/acechar/>.

Coastal Monitoring Data



Water Quality Index

The water quality index for estuaries in the Southeast Coast region is rated fair to good (Figure 4-5). Only 5% of estuarine area was rated poor for water quality, and 45% was rated fair. The water quality index was calculated by combining the indicator values for DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen for Southeast Coast estuaries.

Nutrients: Nitrogen and Phosphorus

High DIN and DIP concentrations in surface waters are often indicators of high eutrophic potential. DIN was rated good because none of the Southeast Coast estuarine area had DIN concentrations that exceeded 0.5 mg/L (Figure 4-6). DIP received a fair rating because 12% of the DIP concentrations exceeded

0.05 mg/L (Figure 4-7). The 12% value for DIP is an approximation because the phosphorus sample was based on filtered, acid-preserved phosphorus for North Carolina samples, which provides a measure of total phosphorus, not of DIP only. Literature suggests that for estuaries in the Southeast Coast region, DIP represents about 97% of the total phosphorus (Van Dolah et al., 2002).

The sampling conducted in the EPA NCA Program has been designed to estimate the percent of estuarine area (nationally or in a region or state) in varying conditions and is displayed as pie diagrams. Many of the figures in this report illustrate environmental measurements made at specific locations (colored dots on maps); however, these dots (color) represent the value of the indicator specifically at the time of sampling. Additional sampling may be required to define variability and to confirm impairment or the lack of impairment at specific locations.

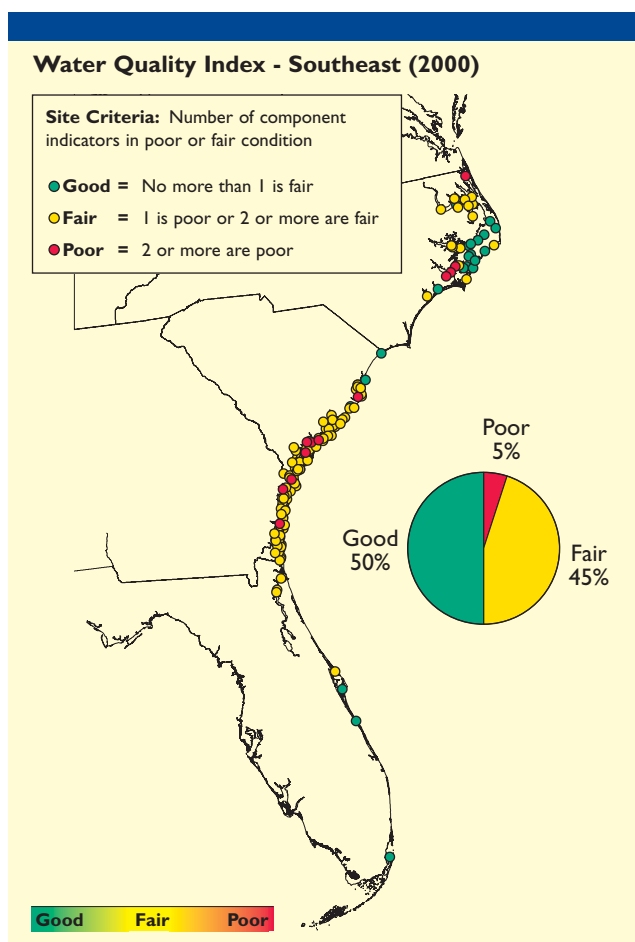


Figure 4-5. Water quality index data for Southeast Coast estuaries (U.S. EPA/NCA).

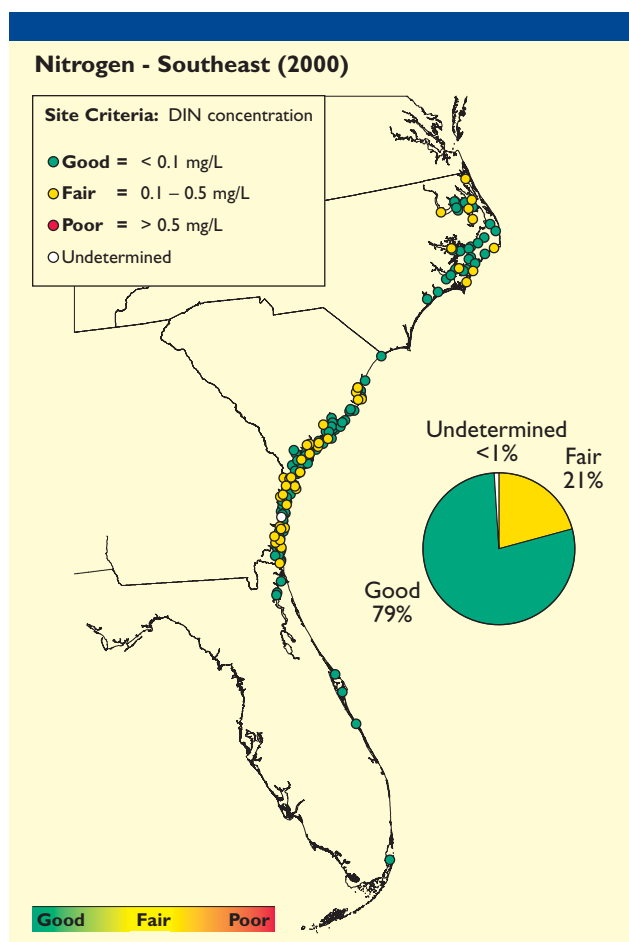


Figure 4-6. DIN concentration data for Southeast Coast estuaries (U.S. EPA/NCA).

Chlorophyll *a*

Chlorophyll *a* received a fair rating because 83% of Southeast Coast estuarine area had concentrations greater than 5 µg/L (Figure 4-8).

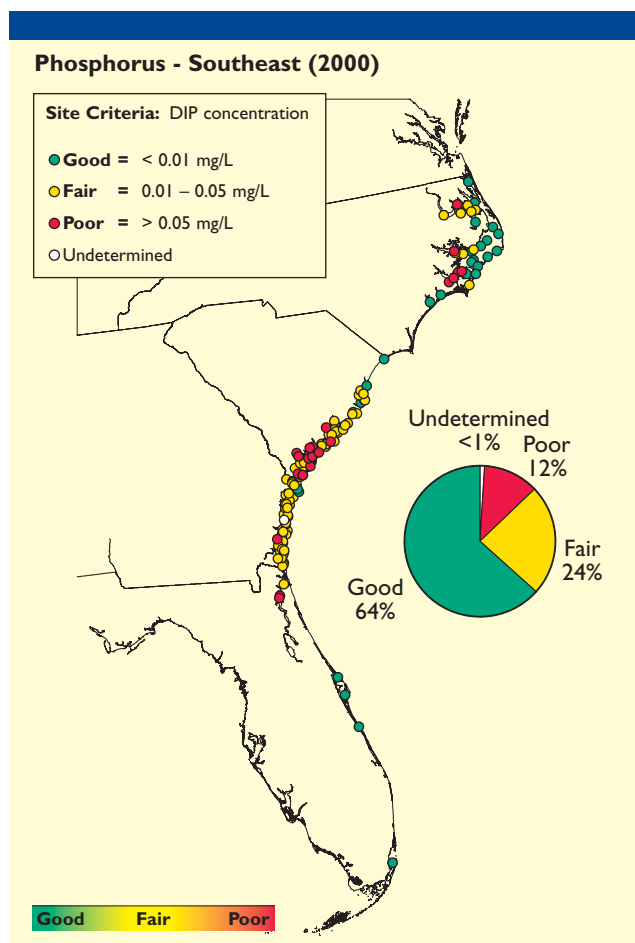


Figure 4-7. DIP concentration data for Southeast Coast estuaries (U.S. EPA/NCA).

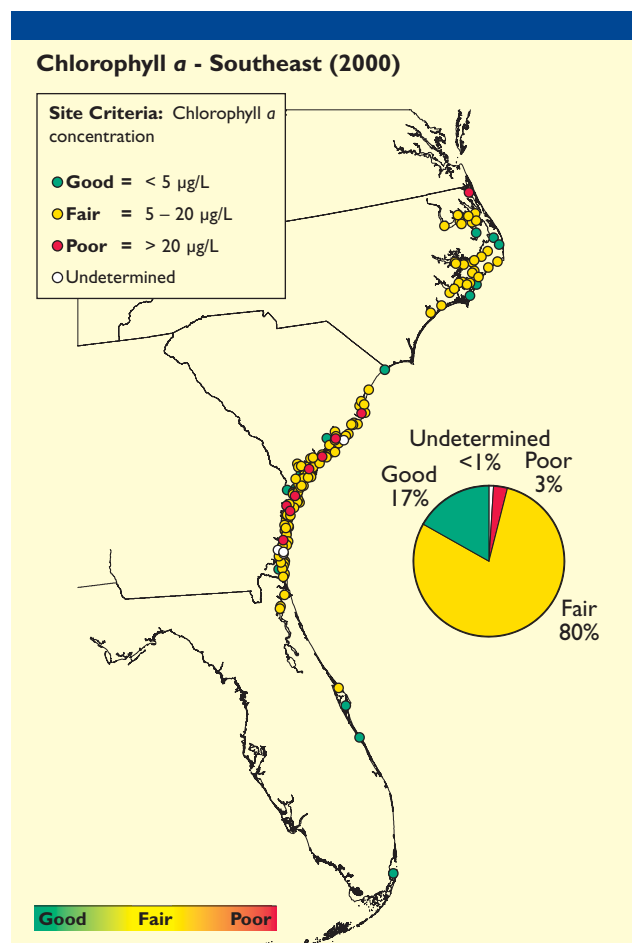
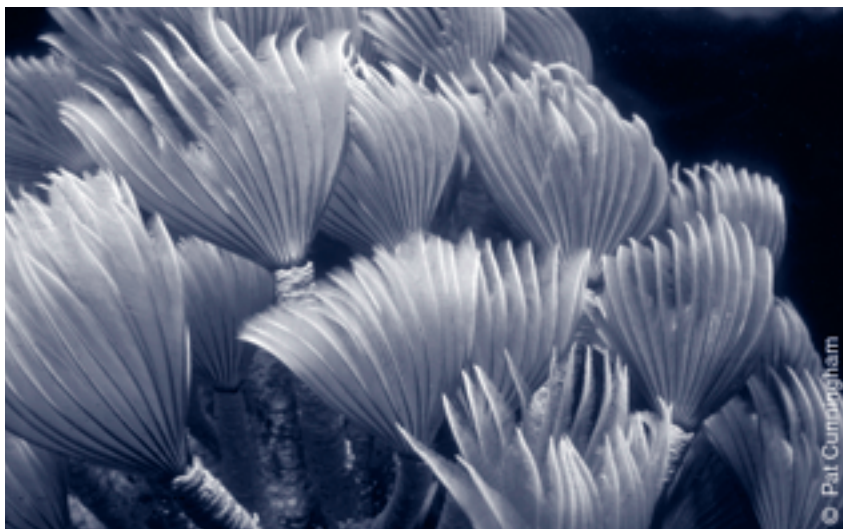


Figure 4-8. Chlorophyll *a* concentration data for Southeast Coast estuaries (U.S. EPA/NCA).



At the slightest disturbance, these social feather duster worms can retract their radioles or food gathering organ back into the safety of their parchment-like tubes (Pat Cunningham).

Water Clarity

Water clarity in Southeast Coast estuaries is fair. Water clarity was estimated by light penetration through the water column using either a transmissivity meter or a Secchi disk. Eighty percent of estuaries have good water clarity, and 12% have poor water clarity (Figure 4-9). Estuaries across the nation were divided into three turbidity classes based on regional expectations for light penetration related to SAV distribution—low, moderate, and high. Highly turbid waters generally have between 5% and 10% transmission of light at 1 meter; moderately turbid waters have between 10% and 25% light transmissivity; and low turbidity waters have between 20% and 40% transmissivity. However, only two turbidity classes were appropriate for most of the Southeast Coast estuaries—high and moderate—because of the high natural organic content of estuaries in the region. By defining reference conditions and ranges for turbidity, measured values can be compared with expected values, taking into account natural causes of turbidity.

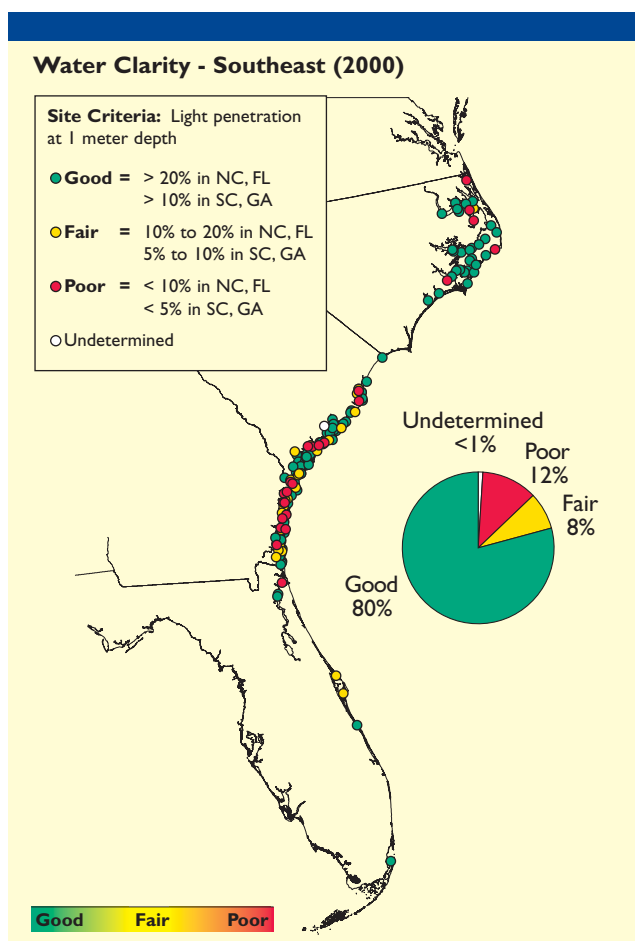


Figure 4-9. Water clarity condition for Southeast Coast estuaries (U.S. EPA/NCA).

Dissolved Oxygen

Dissolved oxygen in Southeast Coast estuaries is good. Twenty-four percent of the bottom waters have dissolved oxygen levels between 2 and 5 mg/L, and 74% of the bottom waters have levels above 5 mg/L (Figure 4-10). Dissolved oxygen is one of the most important water quality measurements because low dissolved oxygen conditions can limit the distribution or survival of most estuarine biota, especially if conditions persist for extended time periods. Results indicate that dissolved oxygen conditions in the Southeast Coast are generally good, even though the NCA Program was designed to sample during the summer index period, when dissolved oxygen levels are at their lowest. The dissolved oxygen measurements collected by states approximate short-term, worst-case conditions that may not necessarily occur for long time periods. State-gathered data under the NCA indicate that only 2% of the bottom waters in Southeast Coast estuaries have dissolved oxygen levels below 2 mg/L.

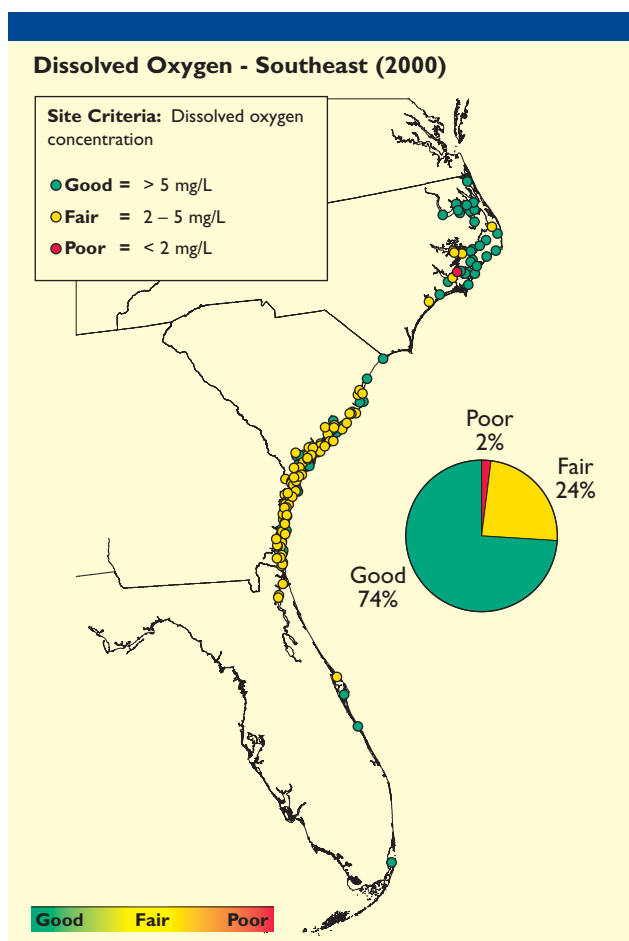


Figure 4-10. Dissolved oxygen concentration data for Southeast Coast estuaries (U.S. EPA/NCA).



Sediment Quality Index

The condition of Southeast Coast estuaries as measured by the sediment quality index is fair to good. Ninety-two percent of estuaries are rated good, and only 8% are rated poor (Figure 4-11). The sediment quality index is calculated using three indicators: sediment toxicity, sediment contaminants, and sediment TOC.

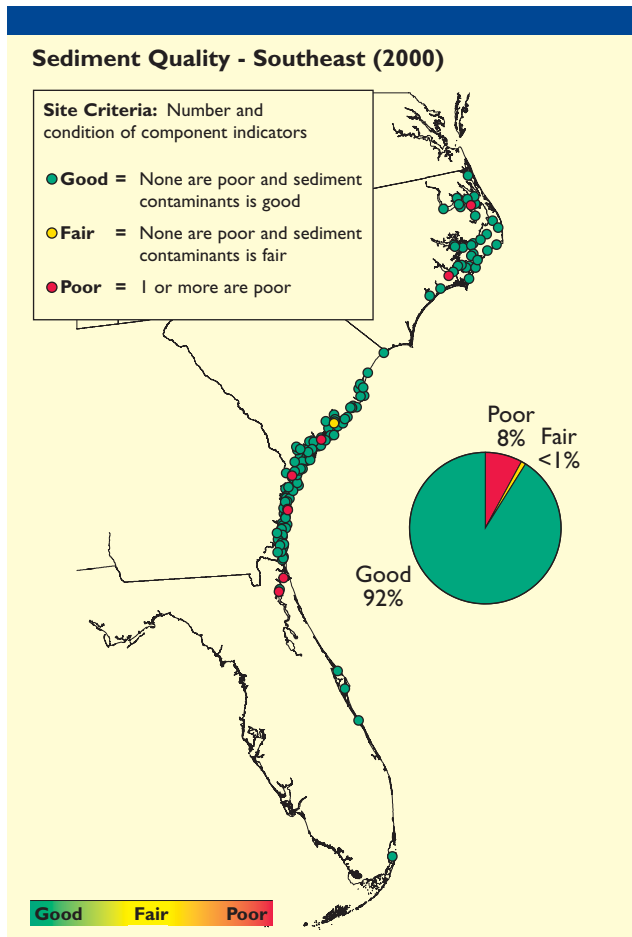


Figure 4-11. Sediment quality index data for Southeast Coast estuaries (U.S. EPA/NCA).



Sediment Toxicity

The sediment toxicity indicator in Southeast Coast estuaries is rated good. Figure 4-12 shows that 86% of the sediment area of these estuaries supported survival of the marine test organism *Ampelisca abdita*. Fourteen percent of the estuaries' toxicity potential was unknown because of missing data or a control failure of the standard toxicity test. Toxicity testing is a valuable tool in assessing the condition of sediments. Sediments received a poor rating if fewer than 80% of the organisms used in the sediment toxicity evaluation survived.

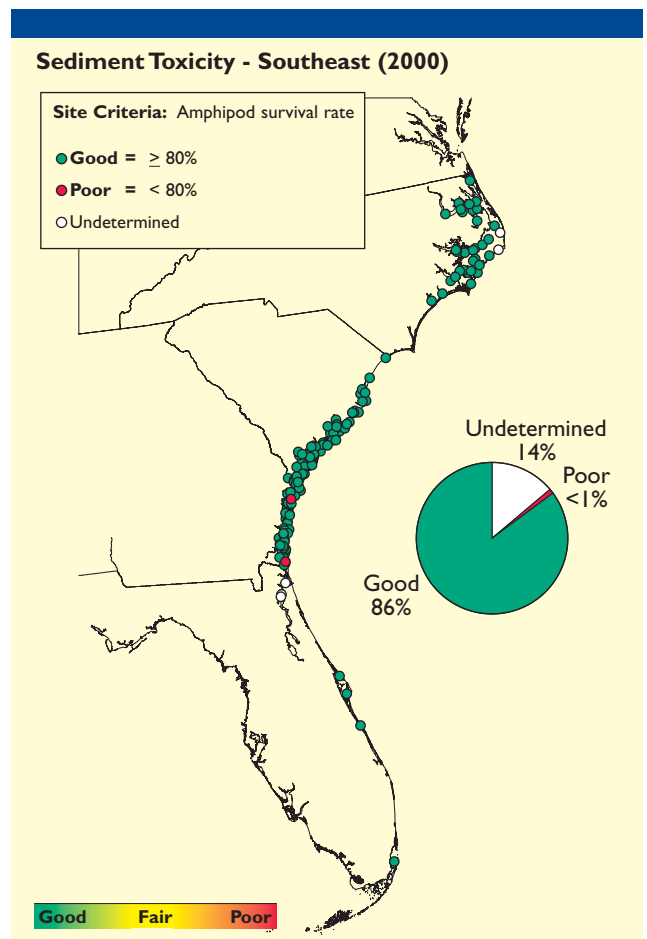


Figure 4-12. Sediment toxicity data for Southeast Coast estuaries (U.S. EPA/NCA).

A banded butterfly fish is a common inhabitant of Atlantic coral reefs (Paul Goetz).

Sediment Contaminants

The condition of Southeast Coast estuaries as measured by sediment contamination is good. For sediment chemical contamination, a poor rating was assigned if concentrations were above ERM values for one or more contaminants, and a fair rating was assigned if concentrations were above ERL values for five or more contaminants. None of the area of Southeast Coast estuarine sediments was rated poor (Figure 4-13). Sediments were analyzed for as many as 28 different chemicals, metals, or chemical classes, and these values were compared with established ERM and ERL values (Long and Morgan, 1990; Long et al., 1995).

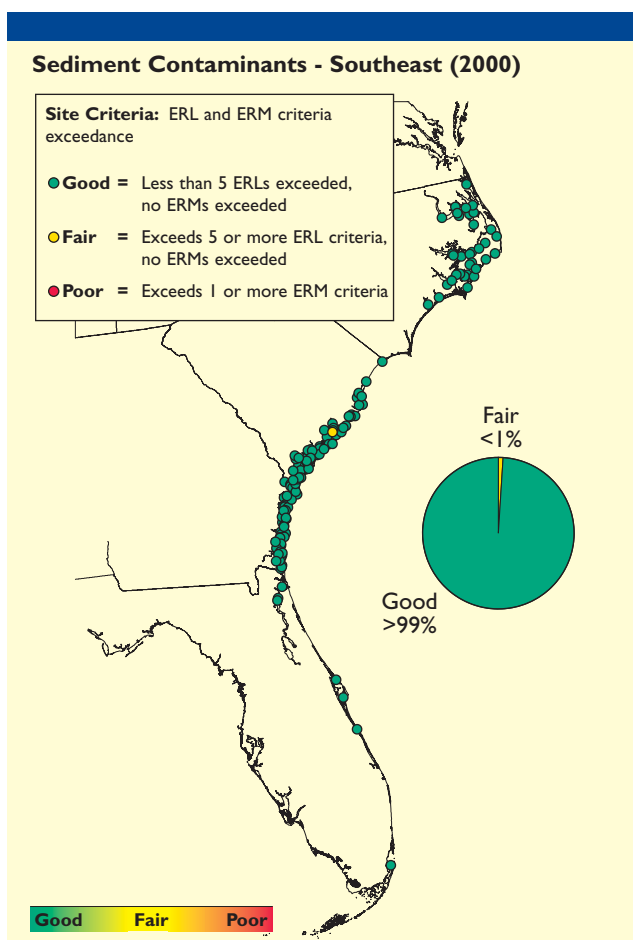


Figure 4-13. Sediment contaminants data for Southeast Coast estuaries (U.S. EPA/NCA).

Sediment Contaminant Criteria (Long et al., 1995)

ERM (Effects Range Median)—Determined for each chemical as the 50th percentile (median) in a database of ascending concentrations associated with adverse biological effects.

ERL (Effects Range Low)—Determined values for each chemical as the 10th percentile in a database of ascending concentrations associated with adverse biological effects.

Sediment Total Organic Carbon

The condition of Southeast Coast estuaries as measured by sediment TOC is good. Figure 4-14 shows that 65% of estuaries in the Southeast Coast region are rated good for TOC, and only 7% are rated poor.

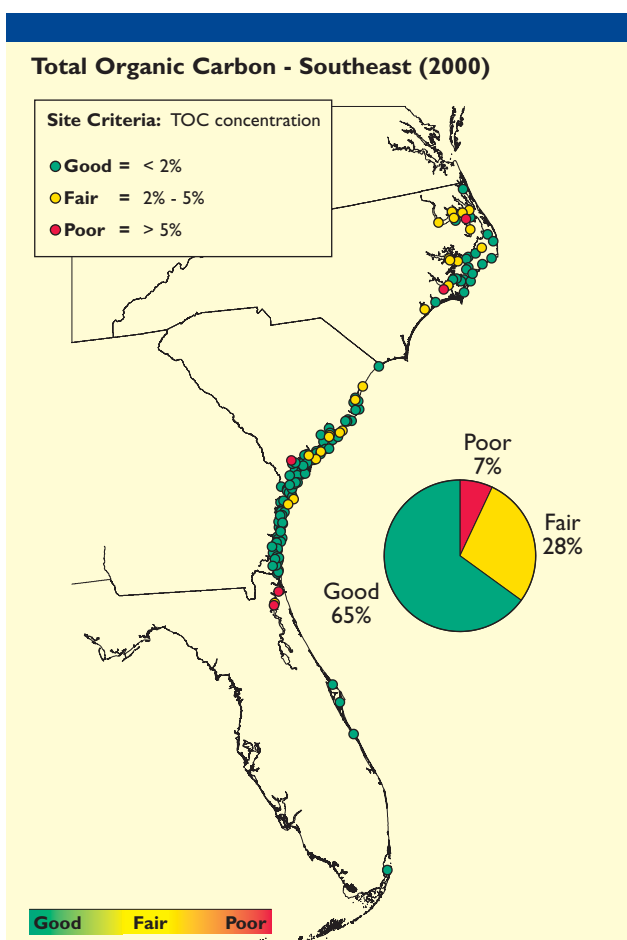


Figure 4-14. Sediment TOC data for Southeast Coast estuaries (U.S. EPA/NCA).

South Carolina Estuarine and Coastal Assessment Program (SCECAP)

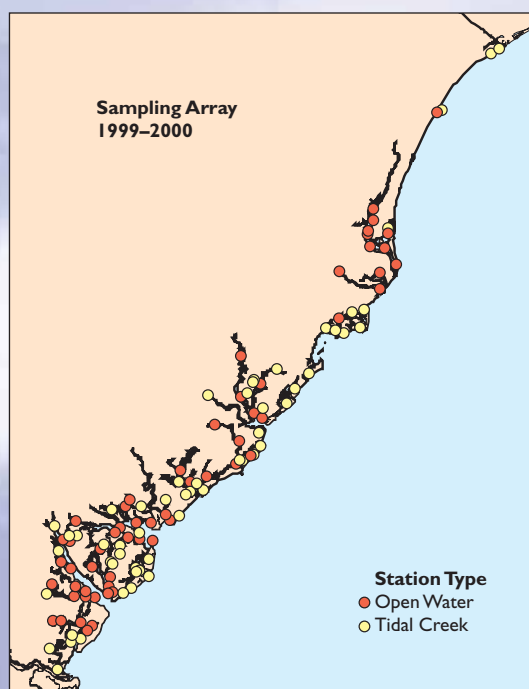
In 1999, the SCDNR and the South Carolina Department of Health and Environmental Control (SCDHEC) initiated a collaborative coastal monitoring program, the South Carolina Estuarine and Coastal Assessment Program (SCECAP). This program involved several federal partners, including EPA, NOAA's National Ocean Service, and the FWS. The goal of SCECAP is to monitor the condition of South Carolina's estuarine habitats and associated biological resources and to provide overview reports to both coastal managers and the public. The program collects multiple water and sediment quality measures and annually monitors the biological condition at approximately 60 probabilistically selected sites throughout the state's coastal zone. These measures are integrated into an overall assessment of habitat condition at each estuarine site and collectively for the state's entire coastal zone. The program also expands the focus of historical monitoring activities beyond open water habitats (e.g., bays, sounds, tidal rivers) to include tidal creeks, which serve as important nursery habitat for many valuable species. As many of these tidal creeks are the first point of entry for nonpoint source runoff from upland areas, they can provide early indications of stress related to coastal development, agriculture, and industrial activities.

The SCECAP Summary Report provides major findings from the first two years of the program. The more detailed SCECAP Technical Report provides additional data on the monitoring program that may be useful to coastal resource managers and to those scientists conducting research in South Carolina's estuaries.



Study results highlight the value of evaluating tidal creek habitats separately from larger open waterbodies. Significant differences were observed for many of the measurements collected in each habitat. Additionally, the study includes newly developed methods for measuring habitat condition that have not been used previously.

Additional information on the SCECAP is available at <http://www.dnr.state.sc.us/marine/scecap/>.

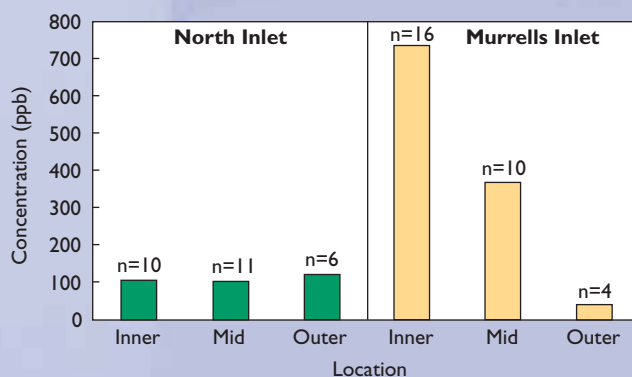


Distribution of open water and tidal creek stations sampled throughout South Carolina's coastal zone during 1999–2000 (SCDNER, 2002).

Comparing and Predicting PAH Concentrations in Urban and non-Urban Sediments

Unmanaged human activity can threaten the environmental health and economic vitality of coastal estuaries. In response to these concerns, as well as to identify the need for spatial models and improved analytical techniques to support sustainable coastal development, a long-term study was initiated to define, measure, and model the impacts of urbanization on high-salinity coastal estuaries of the southeastern United States. The Urbanization and Southeastern Estuarine Systems (USES) Project was begun by the University of South Carolina and the NOAA Center for Coastal Environmental Health and Biomolecular Research. The complexity of estuarine problems currently associated with coastal population growth and commercial development have led many research and management agencies to explore new spatial analytical techniques. These new analytical techniques can provide valid and timely information to assist with productive coastal zone management. This continuing advancement of new technologies enables scientists to design predictive models of how ecosystems and their components respond to natural and man-made pressures. New models and techniques are being developed that incorporate land-use patterns and practices, integrated toxicological and risk assessment modeling, and geographic information processing (GIP) approaches for applied coastal zone management.

Runoff of PAHs discharged from gas combustion engines in automobiles and boats are a major contaminant source in coastal urban watersheds. PAHs were measured in sediments of Murrells Inlet, South Carolina, and found to have distinct patterns showing that the highest PAH concentrations occurred at estuarine sites adjoining urban residential developments, roadways, and marinas. PAH concentrations at estuarine sites in the middle and outer portions of Murrells Inlet distinctly decreased as distance from land-based PAH sources increased. In contrast, at pristine North Inlet, South Carolina, there were no spatial differences in PAH sediment concentrations related to distance from land sources.



Comparison of PAH sediment concentrations at an urbanized site (Murrells Inlet, South Carolina) and a pristine site (North Inlet-Winyah Bay, South Carolina) (Fortner et al., 1996).

Analysis of land use in Murrells Inlet revealed that there were several metrics, such as distance to roadways, distance to marinas, and distance to urban development, that helped develop multi-variate land use models to accurately predict sediment PAH contaminant levels. These findings clearly indicate that high levels of PAHs in sediment are related to land-based pollution sources, and predictions of PAH sediment concentrations within estuarine systems can be accurately based upon simple land use metrics.

For additional information, visit <http://www.chbr.noaa.gov/marineecotoxicology.html>.



Source: Fortner et al., 1996



Benthic Index

The condition of Southeast Coast estuaries as measured by the benthic index is fair. Van Dolah et al. (1999) developed a benthic index based on several measures of benthic community condition. This index considers the total number of species and integrated measures of species dominance, species abundance, and abundance of pollution-sensitive taxa. The index shows that 11% of the Southeast Coast estuarine area is rated poor (has degraded benthic resources), 10% is in fair condition, and 79% is in good condition (Figure 4-15). Areas rated poor included portions of North Carolina's Neuse and Pamlico rivers and Georgia's Savannah River. Of the 11% of estuaries with degraded benthic condition, most (93%) were associated with some measure of adverse water or sediment quality (Figure 4-16). Poor benthic condition co-occurred most often with degraded sediment quality (73% of sites with poor benthic condition).



Tybee Roads, Savannah River Entrance, Georgia (Marge Beaver, Photography Plus).

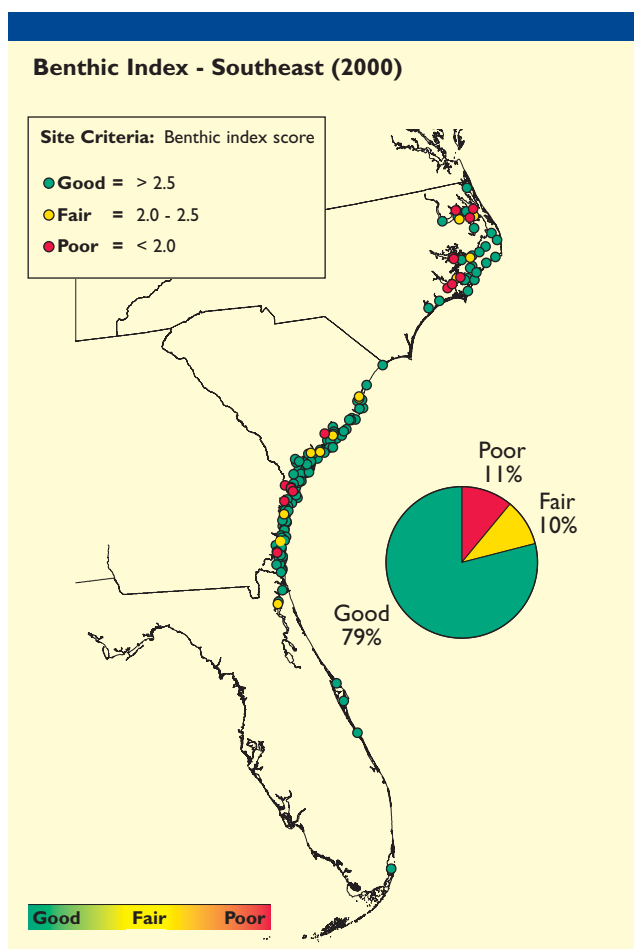


Figure 4-15. Benthic index data for Southeast Coast estuaries (U.S. EPA/NCA).

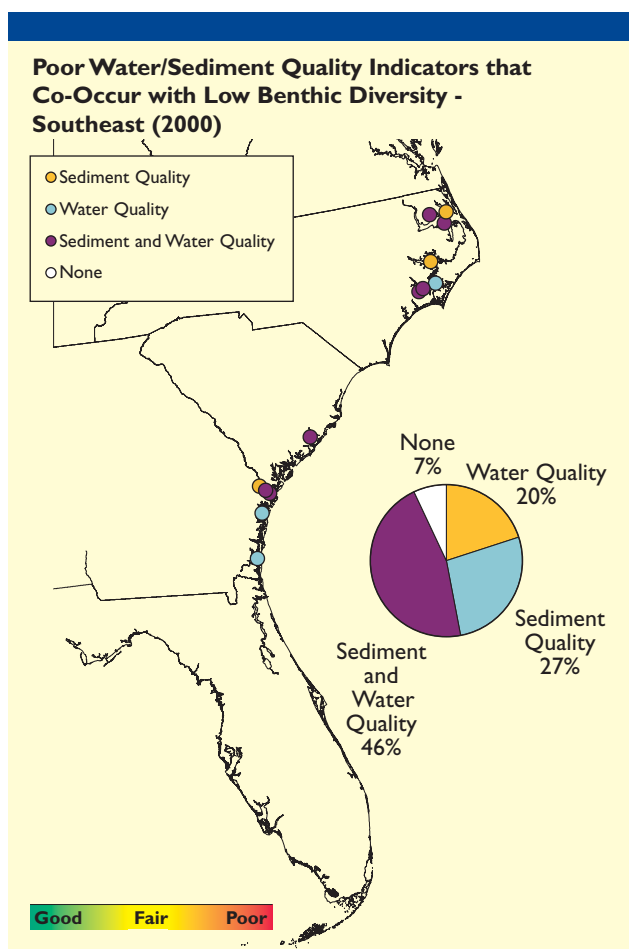


Figure 4-16. Indicators of poor water and sediment quality that co-occur with poor benthic condition in Southeast Coast estuaries (U.S. EPA/NCA).



Coastal Habitat Index

The coastal habitat index for estuaries in the Southeast Coast region is rated fair. Wetlands in the region diminished from 1,107,370 acres in 1990 to 1,105,170 acres in 2000, representing a loss of 2,200 acres or 0.2% (Figure 4-17). The coastal habitat index score was calculated by averaging the mean long-term, decadal wetland loss rate for 1780–1990 with the loss rate for 1990–2000 and multiplying by 100 (for a score of 1.06).

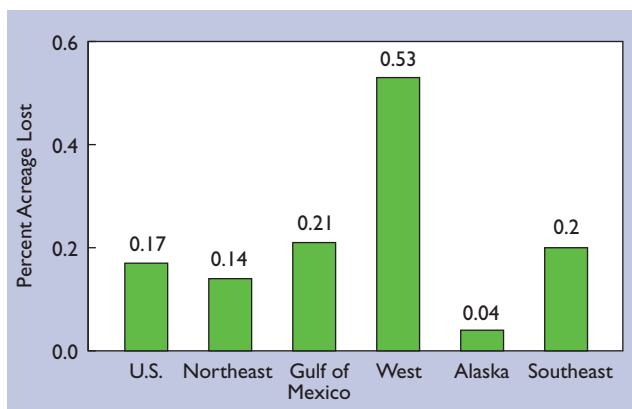


Figure 4-17. Wetland loss data. (Dahl, 2003)



A diver explores a WWII wreck off North Carolina which is now home to schools of juvenile fish and other organisms (Paul Goetz).



Fish Tissue Contaminants Index

The condition of Southeast Coast estuaries based on concentrations of contaminants in fish tissues is rated good. Figure 4-18 shows that 5% of all sites sampled where fish were caught (6 of 119 sites) exceeded risk-based criteria guidelines using whole-fish contaminant concentrations. (Whole-fish contaminant concentrations can be higher or lower than the concentrations associated with fillets. Only those contaminants that have an affinity for muscle tissue, e.g., mercury, are likely to have higher fillet concentrations. Fillet contaminant concentrations for most other contaminants will be lower.) The only contaminants that had elevated concentrations in fish tissues in Southeast Coast estuaries were total PAHs and total PCBs.

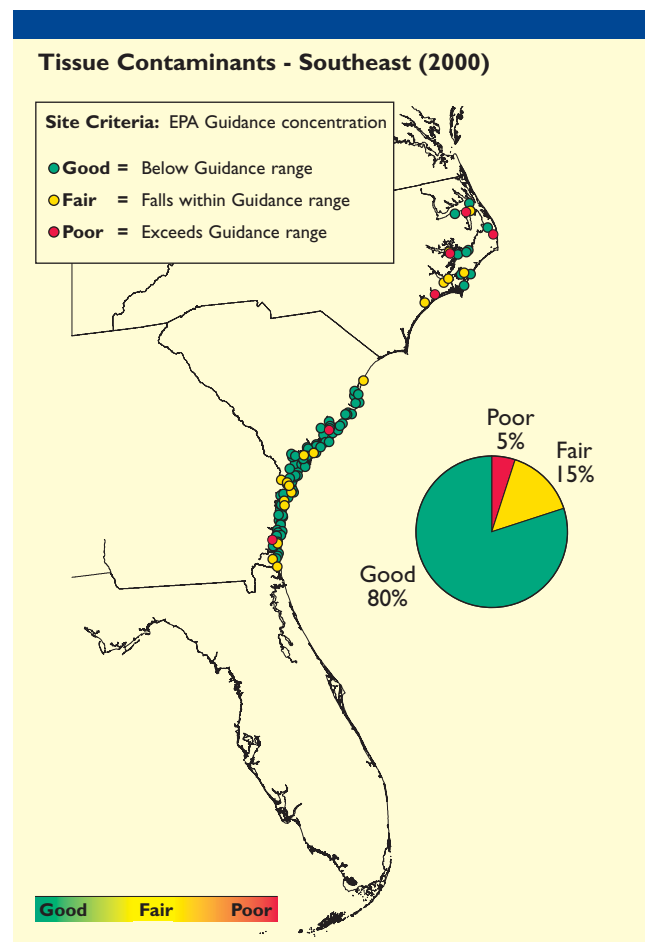


Figure 4-18. Fish tissue contaminants data for Southeast Coast estuaries (U.S. EPA/NCA).

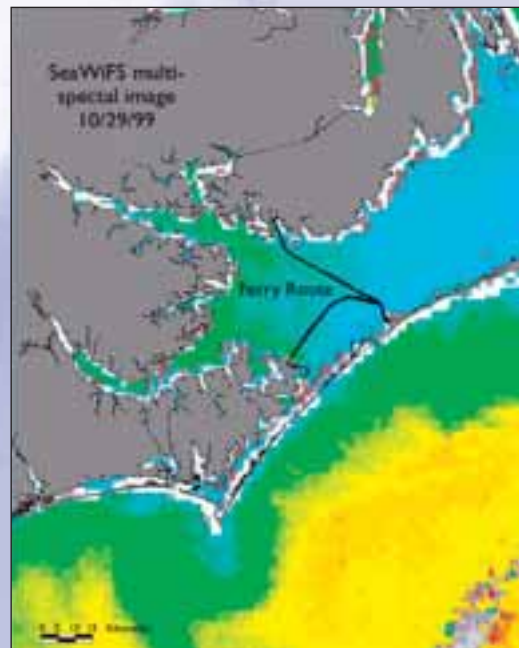
Using Ferries to Monitor Estuarine Water Quality

The Albemarle-Pamlico Estuarine System (APES) is the second largest estuary in the nation. It supports more than 75% of the commercial fisheries in the Southeast and is North Carolina's most important recreational, tourism, and fisheries resource. However, despite its enormous ecological and socioeconomic importance, the majority of the APES is not routinely monitored for water quality.

This estuarine system's resources are threatened by increased pollution from urban and agricultural development in its watersheds. To address the urgent need for rapid, cost-effective, management-oriented water quality assessment, the University of North Carolina at Chapel Hill (UNC) and Duke University have partnered with the North Carolina Department of Environment and Natural Resources and the Department of Transportation to monitor the estuary's ecological health. The partnership, called FerryMon, outfitted three ferries that cross the Albemarle-Pamlico Sound and its tributaries as cost-free "ships of opportunity" with equipment to monitor the estuary's ecological indicators 18 hours a day, 365 days a year. These ferries collect real-time water quality data, including data related to temperature, salinity, dissolved oxygen, turbidity, pH, and chlorophyll. They also collect water samples for nutrient and diagnostic photopigment analyses. Data are transmitted via cell phone to laboratories, water quality management agencies, schools, environmental and outreach groups, and commercial and recreational fishing communities.

FerryMon is administered by the Carolina Environmental Program. Principal investigators are Hans W. Paerl, Kenan Professor of Marine and Environmental Sciences at UNC's Institute of Marine Sciences in Morehead City, North Carolina, and Joseph S. Ramus, professor at the Duke University Nicholas School of the Environment and Earth Sciences Marine Laboratory in Beaufort, North Carolina.

Additional information on this program is available at <http://www.ferrymon.org>.



Albemarle-Pamlico Estuarine System (APES) (map courtesy of FerryMon, 2003)

Large Marine Ecosystem Fisheries

The Atlantic coast of the United States bordering on the Southeast Shelf LME includes diverse habitats ranging in salinity, flora, and fauna. It includes freshwater and estuarine habitats, nearshore and barrier islands, and oceanic communities. Watersheds that drain the lower Appalachian Mountains, Piedmont, and Coastal Plains empty into the ecosystem along the coastlines of North Carolina, South Carolina, Georgia, and eastern Florida. The flow of fresh water mixes along the coast with prevailing oceanic waters to create diverse wetlands, marsh, and mangrove habitats that transition gradually from freshwater to brackish to saltwater areas. From an ecosystem perspective, this thin fringe of estuaries is dynamic, varying constantly with tidal fluctuations and levels of runoff, and it serves as an important habitat for waterfowl, reptiles, mammals, fish, and invertebrates, as well as a diversity of plants. It also serves as a natural filter to remove pollutants and sediments from upland regions. The estuaries in this area support diverse aquatic organisms and complex food webs in an irreplaceable nursery system. This system promotes the recruitment and development of juvenile fish and invertebrate species that are important to recreational, commercial, and ecological interests.

Reef Fish Resources

In the Southeast Shelf LME, the fishery for reef fishes has historically been conducted within waters that are less than 600 feet deep, or within the area that approximates the outer edge of the continental slope. Reef fishes are generally found on reef or reef-like, hard-bottom habitats. Dominant reef fish species include red, yellowtail, vermilion, and mutton snappers; red and gag groupers; black sea bass; and greater amberjack. Reef fish fisheries are extremely diverse, have many users (commercial and recreational), and vary greatly by location and species.

Combined commercial and recreational landings of the reef fishes from the Southeast Shelf LME area have fluctuated since 1976, showing a slightly decreasing trend over time (Figure 4-19). Meanwhile, fishing pressure has increased significantly. NOAA's FMP prohibits the use of fish traps (except pots for black sea bass) and trawl gear. Other regulations pertaining to the management of reef fishes include minimum size limits, permitting systems for commercial fishermen, bag

limits, quotas, seasonal closures, Special Management Zones, and the establishment of Marine Protected Areas prohibiting the harvest of any species.

Of the dominant reef fishes within the ecosystem of the Southeast Shelf, the red, yellowtail, and vermilion snappers, the red and gag groupers, and the black sea bass stocks are currently overfished. The mutton snapper and greater amberjack stocks are not considered to be overfished. The regulatory measures and stock rebuilding plans under way are designed to reduce fishing mortality, to prevent over fishing, and to continue or begin rebuilding of these stocks.

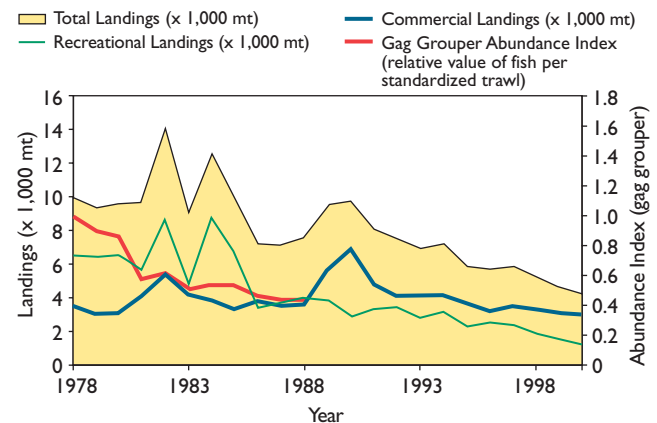


Figure 4-19. U.S. Atlantic coast reef fish landings, 1978–2000, in metric tons (mt). The abundance index is a relative value showing fish per standardize haul (NMFS, 2003).



The black sea bass (*Centropomus striata*), also known as the blackfish, has short, blue-black fins with white areas on the head. The last dorsal spines may have a dark spot at the base. It is the most common predator at Gray's Reef, South Carolina (Karen Roeder).

Sciaenids Fisheries

Fishes of the family *Sciaenidae* include 22 species in the Southeast Shelf LME. Some of the more notable members of this family of fishes include red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), spotted seatrout (*Cynoscion nebulosus*), kingfish (*Menticirrhus spp.*), and spot (*Leiostomus xanthurus*). Sciaenids have constituted an important fishery resource along the Atlantic coast since the late 1800s. Currently, these fish species support substantial harvests for both commercial and recreational fisheries and are captured in almost every type of gear used to fish the coastal waters of the Atlantic.

Of those sciaenid species for which an FMP has been developed, red drum are currently classified as overfished in some states; weakfish have high levels of abundance; and information needed to adequately determine stock status of the remaining species is lacking. Regulations for sciaenid fishes in the Atlantic range from no restrictions in some states to complicated restrictions based on fish size and bag limits in other states. The populations of several species of sciaenids, most notably Atlantic croaker and spotted seatrout, appear to be closely linked to environmental conditions, which result in large annual fluctuations in population levels.



Pond stocking of red drum fingerlings for Florida stock-enhancement programs. Netting covering the ponds prevents bird predation on stock. Port Manatee, Florida (Eileen McVey, NOAA Central Library).

Menhaden Fishery

Landings and participation (23 factories and more than 100 vessels on the Atlantic coast) in the menhaden fishery increased rapidly after World War II (Figure 4-20), reaching peak harvests between 1953 and 1962 (record landings of 712,100 mt in 1956). Sharp declines in landings thereafter resulted in plant closings and vessel reductions. The stock rebuilt during the 1970s and 1980s, and menhaden landings climbed to 418,600 mt in 1983. In 1990, 5 reduction plants operated with about 37 vessels. During the late 1980s and 1990s, the fishery consolidated, primarily because of low product prices. In 2003, only two plants remained on the Atlantic coast (Reedville, Virginia, and Beaufort, North Carolina), with a total of 12 steamers. The Virginia portion of Chesapeake Bay is currently the center of the modern menhaden fishery. Landings since 1998 have ranged between 167,200 and 245,900 mt (landings in 2002 were 174,000 mt).

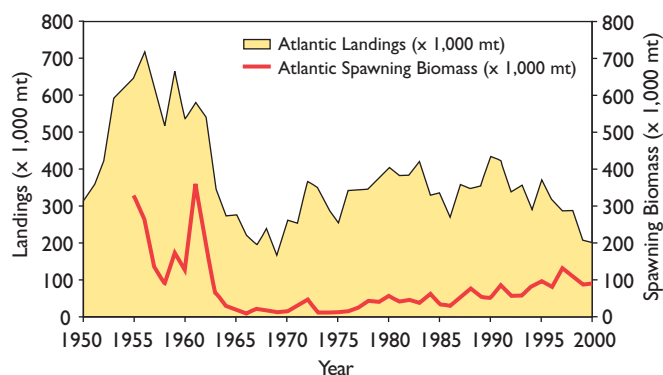


Figure 4-20. Landings and spawning biomass of Atlantic menhaden, 1950–2000, in metric tons (mt) (NMFS, 2003).

Declining fishing effort (hence fishing mortality) in recent years has likely reduced the rate at which older menhaden are removed from the population, allowing time for fortuitous recruitment. Relatively low survival to the age of 1 year has been a major concern for the Atlantic menhaden stock. The last dominant year-class occurred in 1988, and subsequent year-classes have generally been poor to mediocre. Recruitment appears to be hindered largely by environmental conditions (centered in the Chesapeake Bay area) rather than by a lack of spawning stock. If recruitment continues to decline, erosion of the spawning stock may follow.

Mackerel Fisheries

Total catch of Southeast Shelf LME king mackerel averaged 3,345 mt per fishing year from 1981 to 2001, with a maximum of 4,365 mt (1985) and a minimum of 2,570 mt (1999). In 2001, the total catch was 2,748 mt. On average, the landings are larger for the recreational sector (66%) than for the commercial sector (34%). Landings of king mackerel have been below the total allowable catch limitations since 1986. According to the 1998 and 2003 stock assessments, this stock is not overfished, nor is overfishing occurring, although it is near its estimated long-term potential yield. Currently, there are restrictions for the commercial sector, including annual total allocated catch restrictions, minimum size restrictions, gear restrictions, and catch trip limits. For the recreational sector, restrictions include bag limits, minimum size limits, and annual quota allocation. Current issues affecting the Atlantic king mackerel stock concern the bycatch of juveniles in the shrimp trawl fishery and the allocation of landings within the mixing zone between Atlantic and Gulf stocks.

The total catch of Southeast Shelf LME Spanish mackerel averaged 2,307 mt per fishing year from 1984 to 2001, with a maximum of 3,188 mt (1991) and a minimum of 1,406 mt (1995). In 2001, the total catch was 2,305 mt; in contrast to landings for king mackerel, most of the landings for Spanish mackerel are from the commercial sector (69%). For the Southeast Shelf LME Spanish mackerel, landings have also been below the total allowable catch limitations, at least since 1991. The 1998 and 2003 stock assessments concluded that the Atlantic Spanish mackerel stock was not overfished and that overfishing was not occurring, although current estimates indicate that the stock is exploited at its near-optimum long-term yield. At present, management restrictions for the commercial fishery of Southeast Shelf LME Spanish mackerel include minimum size restrictions, gear restrictions, trip limits, and quota allocation. For the recreational fishery, there are minimum size restrictions, bag limits, and charter-vessel permit requirements. Current issues affecting this stock include bycatch from the shrimp trawl fishery and the allocation of landings within the mixing zone between Atlantic and Gulf stocks.

Catch statistics indicate that commercial shrimp species are being harvested at maximum levels. This photo shows three commercial shrimp boats (Ralph F. Kresge).

Shrimp Fisheries

The trend in commercial landings of the major shrimp species over the last 40 years has remained stable, while fishing pressure has increased. The shrimp stocks in the Southeast Shelf LME appear to be more affected by environmental conditions than by fishing pressure. Both pink and white shrimp populations are affected by cold weather. The young of these species overwinter in estuaries and can potentially “freeze out” if water temperatures drop to lethal levels. The lower temperatures do not affect brown and rock shrimp because juveniles are not found in the estuaries during cold seasons. Annual variations in white and pink shrimp populations due to fluctuating environmental conditions are a natural phenomenon that will likely continue to occur despite management activities. However, the recovery of the affected stocks can be mediated by management practices.

The current shrimp management plan uses the mean total shrimp landings as a reasonable proxy for maximum sustainable yield. The harvest of shrimp in the Southeast Shelf LME has fluctuated around stable levels for several years. This trend in landings has been maintained even though an increase in vessels has been observed; therefore, it seems these stock are fully exploited.

The latest NMFS catch statistics indicate that commercial shrimp species are being harvested at maximum levels. An increase in effort would most likely not lead to an increase in catch. Although the take of shrimp may affect future stocks in years experiencing harsh environmental conditions, the greatest threat to shrimp populations is the loss or destruction of habitat. Pollution or physical alteration of the salt marsh and inshore seagrass habitats results in changes to habitats that are critical nursery areas for juvenile shrimp.

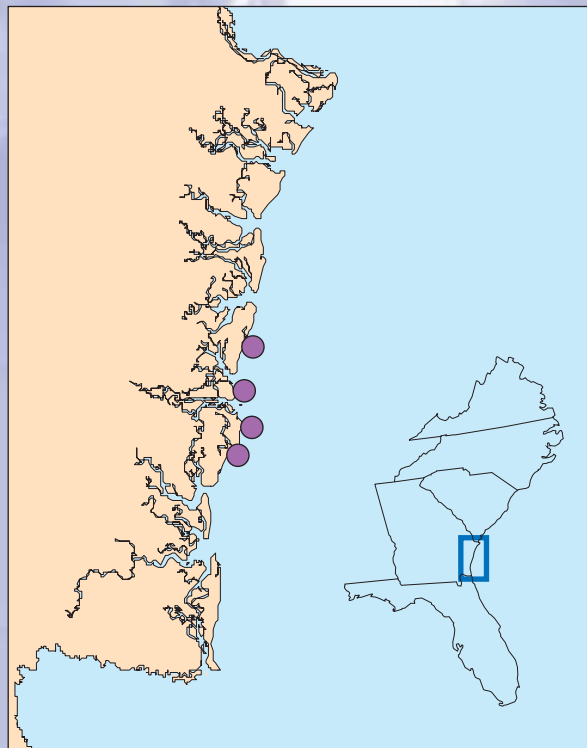


Georgia Department of Natural Resources' Red Drum Project

Conventional tagging and telemetry studies have demonstrated that the Altamaha River delta provides an important habitat for all life stages of red drum. These studies have shown that adult red drum exhibit spawning site fidelity. After spawning, adult red drum aggregate at shoal and sandbar areas near the mouths of estuaries, where they are targeted by anglers in a growing catch-and-release fishery. Adult red drum remain in these areas until mid-November, when they move out into the open Atlantic Ocean, returning to the estuaries and nearshore waters the following spring.

Through a 2-year age-determination study (1989 to 1991), approximately 300 red drum were captured from the Altamaha River delta with hook-and-line and entanglement gear and then sacrificed for otolith (ear bone) removal and collection of biological data. Evaluation of otoliths revealed that the portion of the adult red drum spawning biomass that frequented the Altamaha River delta was comprised of individuals ranging from age 5 to 40. Young adults (ages 5 to 10) made up a much smaller portion of the sample than expected. As a result, researchers concluded that unregulated harvest of juveniles and sub-adults during the 1970s and 1980s had decreased survival to adulthood.

In the autumn of 2002, the Coastal Resources Division repeated this study, collecting adult red drum from four stations located in the Altamaha River delta using both conventional angling and multi-hook gear with circle hooks as terminal tackle. The goal of this repeat study was to determine and compare the current and historical age structures of the red drum with the previous 2-year study of 1989. If management guidelines implemented over the past decade have been successful, then young adult red drum should represent a larger portion of the spawning population.



Georgia, Red Drum sampling sites (map courtesy of Georgia Department of Natural Resources, Coastal Division, 2002).

In addition, 10 randomly selected individuals (>750 mm fork length) were taken from each of the 4 sampling stations for tissue chemistry analysis. Comparison of the tissue concentrations with sediment chemistry data collected from random sites in 2000 and 2001 in the Altamaha estuarine system will provide unique insight about bioaccumulation of water and sediment-borne substances.

For more information about the Red Drum Project, contact Phillip Flournoy at phillip_flournoy@coastal.dnr.state.ga.us.



Photo courtesy of Georgia's Department of Natural Resources, Coastal Division, 2002.

Assessment and Advisory Data

Clean Water Act Section 305(b) Assessments

The states on the Southeast Coast assessed 8,234 (93%) of their 8,813 estuarine square miles for their 2000 305(b) reports. Of the assessed estuarine square miles on the Southeast Coast, 81.5% fully support their designated uses, 1.5% are threatened for one or more uses, and the remaining 17% are impaired by some form of pollution or habitat degradation (Figure 4-21). Individual use support for assessed estuaries is shown in Figure 4-22. The states on the Southeast Coast did not assess any of their 9,070 shoreline miles. Although Florida reports water quality information for coastal waters for Section 305(b) compliance, it is not possible from that report to distinguish between Atlantic and Gulf Coast listings; therefore, 305(b) assessment information for Florida is included in its entirety in this section.

Table 4-1 shows individual use support reported by states for their assessed estuaries and shoreline waters.

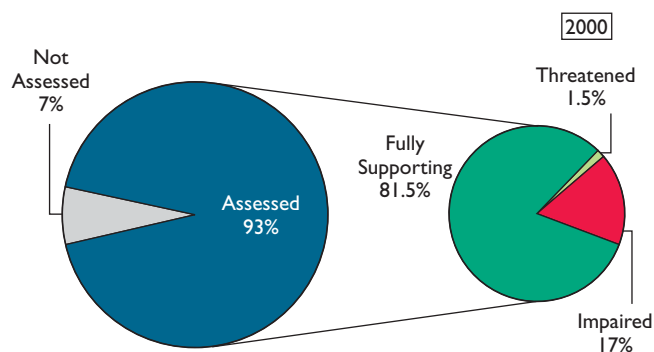


Figure 4-21. Water quality in assessed estuaries of the Southeast Coast (U.S. EPA, 2002).



Wind surfer takes advantage of the coastal wind and waves for an exciting ride (Paul Goetz).

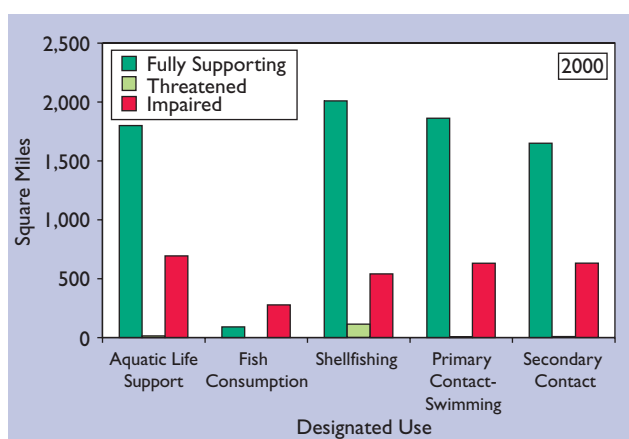


Figure 4-22. Individual use support for assessed estuaries of the Southeast Coast (U.S. EPA, 2002).

Table 4-1. Individual Use Support for Assessed Coastal Waters Reported by the Southeast Coast States under Section 305(b) of the Clean Water Act for 2000 (U.S. EPA, 2002).

Individual Uses	Estuaries Assessed as Impaired (mi ²)	Percentage of Total Area Assessed for Individual Use
Aquatic life support	683	27%
Fish consumption	279	76%
Shellfishing	534	20%
Primary contact – swimming	623	25%
Secondary contact	606	27%



Portuguese Man-O-War frequently washup Florida's east coast during the spring to threaten beach goers and swimmers alike with their potent and sometimes lethal stinging tentacles (Pat Cunningham).

Fish Consumption Advisories

Ten fish consumption advisories were active in the coastal waters of the Southeast Coast region in 2002 (Figure 4-23). All four coastal states—North Carolina, South Carolina, Georgia, and Florida—had statewide advisories covering all coastal waters and estuaries to warn citizens against consuming large quantities of king mackerel because of potential mercury contamination. Florida and South Carolina also have statewide advisories for other species of fish. Because of these statewide advisories, 100% of the total coastline miles of the Southeast Coast region were under advisory. Most (90%) fish consumption advisories for the Southeast Coast were issued at least in part because of mercury contamination (Figure 4-24), with separate advisories issued for only two other pollutants, PCBs and dioxins. All PCB advisories were in Georgia, and the one dioxin advisory was in North Carolina's Albemarle-Pamlico Sound.

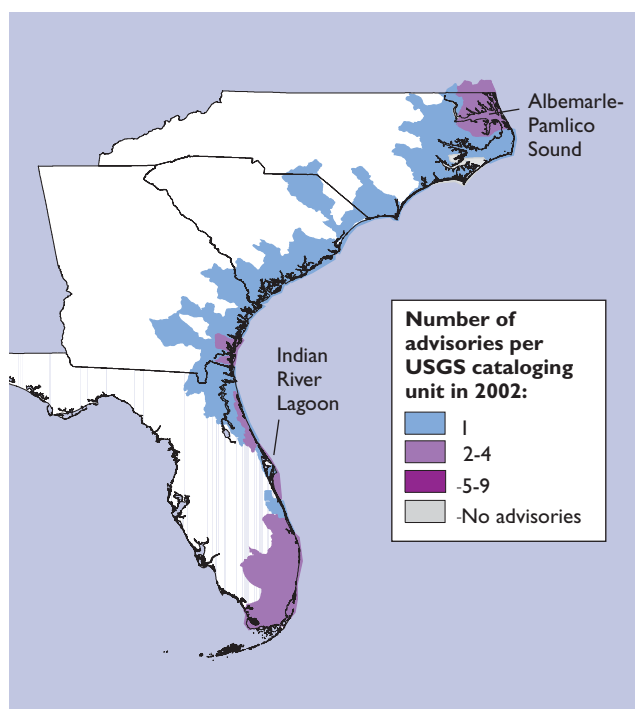


Figure 4-23. The number of fish consumption advisories per USGS cataloging unit in Southeast Coast waters (U.S. EPA, 2003c).

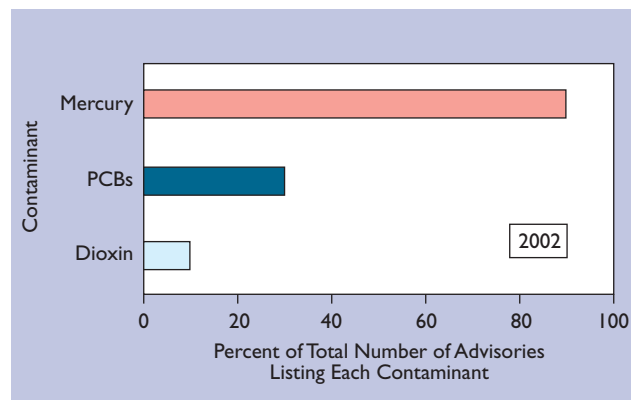


Figure 4-24. Pollutants responsible for fish consumption advisories in Southeast Coast waters. An advisory can be issued for more than one contaminant, so percentages may not add up to 100 (U.S. EPA, 2003c).

These species were under advisory in 2002 for at least some part of the Southeast Coast:

Almaco jack	Greater amberjack
Atlantic croaker	King mackerel
Black drum	Ladyfish
Blackfin tuna	Little tunny
Blue crab	Mussels
Bluefish	Oysters
Carp	Red drum
Catfish	Shark
Clams	Silver perch
Cobia	Snowy grouper
Crevalle jack	Spotted seatrout
Flounder	

Source: U.S. EPA, 2003c



A blue crab fishing boat loaded with pots and ready to go to work. Mann's Harbor, North Carolina (William B. Folsom, NMFS).

Beach Advisories and Closures

Of the 151 coastal beaches in the Southeast Coast that reported information to EPA, only 15.6% (25 beaches) were closed or under an advisory for any period of time in 2002. Table 4-2 presents the numbers of beaches, advisories, and closures for each state. Only South Carolina and Florida's east coast had beaches with advisories or closures. Figure 4-25 presents advisory and closure percentages for each county within each state.

Table 4-2. Number of Beaches and Advisories/Closures in 2002 for Southeast Coast States (U.S. EPA, 2003a)

State	No. of Beaches	No. of Advisories/Closures	Percentage of Beaches Affected by Advisories/Closures
North Carolina	20	0	0.0%
South Carolina	26	12	46.2%
Georgia	4	0	0.0%
Florida (East Coast)	101	13	12.9%
TOTALS	160	25	15.6%

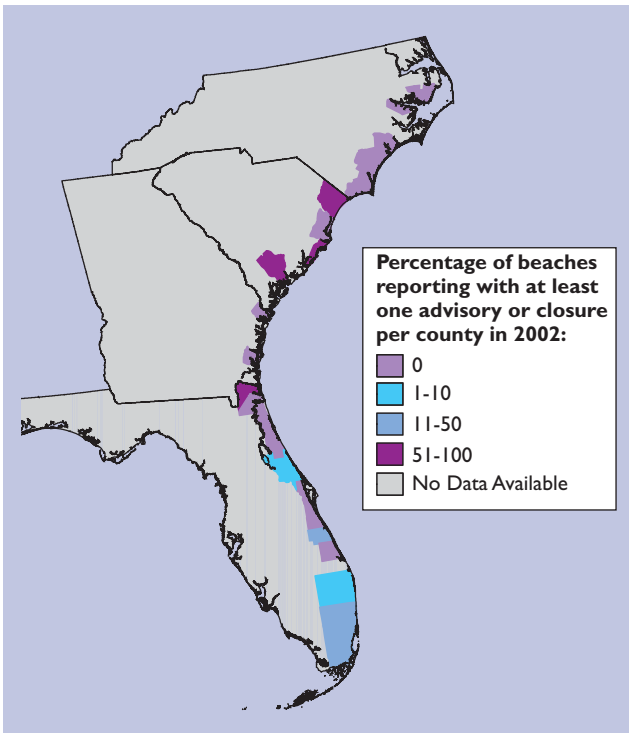


Figure 4-25. Percentage of Southeast Coast beaches with advisories or closures by county in 2002 (U.S. EPA, 2003a).

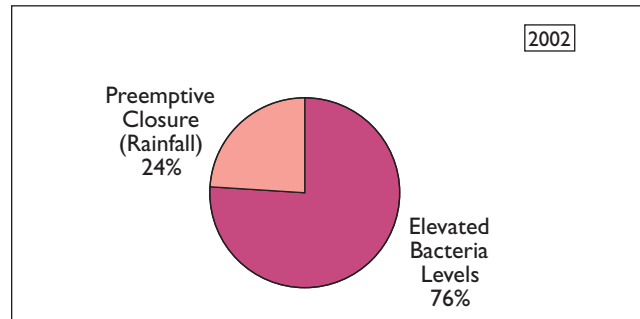


Figure 4-26. Reasons for Southeast Coast beach advisories or closures (U.S. EPA, 2003a).

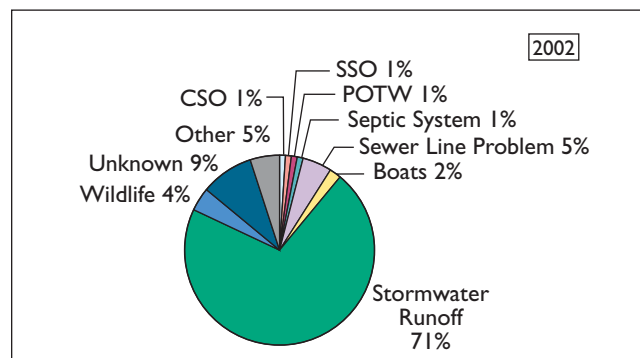
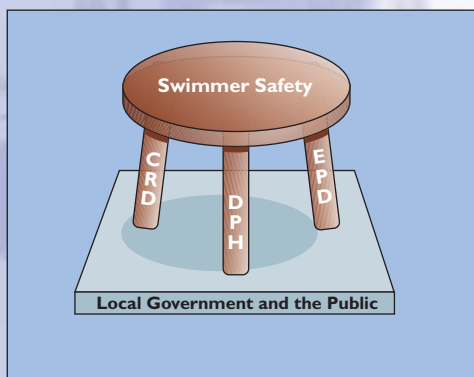


Figure 4-27. Sources of Southeast Coast beach contamination (U.S. EPA, 2003a).

Georgia Beach Monitoring Program

The primary goal of the Georgia Beach Monitoring Program is swimmer safety. The Georgia Department of Natural Resources (DNR), Coastal Resources Division (CRD), is developing an interagency team to address issues that influence swimmer safety. The team consists of the CRD; the State Department of Human Resources, Division of Public Health (DPH); and the DNR Environmental Protection Division (EPD). The team has three primary responsibilities: (1) to monitor regular bacterial water quality; (2) to notify the public of swimmer health risks; and (3) to investigate sources of pollution.

CRD used the analogy of a three-legged stool to explain the team's approach. Swimmer safety is the seat of the stool, and the stool is supported by three legs. All three legs are required to keep the stool upright, but no single agency in Georgia has the jurisdiction to provide the information needed for all three legs. The CRD is the leg that monitors bacterial concentration in water. When bacterial concentrations are high, CRD notifies the DPH. The DPH is the leg that issues a public health advisory. The third leg, the EPD, investigates the source of the bacterial contamination.



The stool requires a stable platform for support and stability. That platform consists of local governments, beach management agencies, news agencies, and the general public. The CRD has worked to educate the groups that form this platform to provide the necessary support for the Georgia Beach Monitoring Program in order to increase the groups' awareness of swimmer safety issues and to explain how their support can help improve swimmer safety.

For more information, contact Elizabeth Cheney at elizabeth_cheney@coastal.dnr.state.ga.us.



Summary



Lighthouse and palmetto trees (Richard B. Mieremet, Senior Advisor, NOAA OSDIA).

The overall condition of Southeast Coast estuaries is fair to good. Monitoring by coastal states in 2000 showed that less than 5% of the area of Southeast Coast estuaries and coastal areas is in poor condition, based on bottom dissolved oxygen concentrations, sediment toxicity, and sediment chemical contamination. Indices of concern include the benthic index (11% rated poor), water quality index (50% rated as fair or poor), and coastal habitat index (1.06 rated as fair). Although only 3% and 12% of Southeast Coast resources were in poor condition for chlorophyll *a* and phosphorus concentrations, respectively, large percentages (80% and 24%) of resources were in fair condition for these two indicators.

Results indicate that most of the estuarine area of the southeastern United States is in fair to good ecological condition. Neither environmental stressors (e.g., dissolved oxygen, contaminants) nor conditions for aquatic life showed signs of serious ecological impairment during the monitoring period. However, increasing population growth in this region of the United States could contribute to increased susceptibility for water quality degradation. Although the overall condition of Southeast Coast estuaries is rated fair to good for 2000, a vigilant attitude should be promoted and environmental education continued to protect and preserve this resource.